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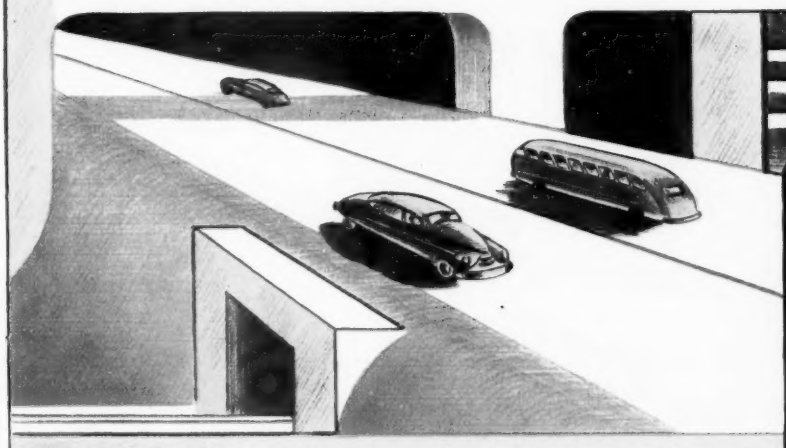

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## In This Issue

September 1949


- **Safety Record Improved in The National Crushed Stone Association Safety Competition of 1948**
- **Traffic Bound Roads**
- **W. E. Farrell—In Memoriam**


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Official Publication of the NATIONAL CRUSHED STONE ASSOCIATION

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## Contents

Page

Safety Record Improved in The National Crushed Stone Association Safety Competition of 1948 —E. K. Elsner and P. N. Guinan - - 3

Traffic Bound Roads —Joseph E. Gray - - - - - - - - 10

W. E. Farrell—In Memoriam - - - - - - - - - - 14

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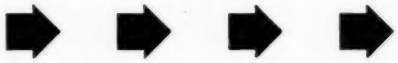

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THE
CRUSHED STONE JOURNAL

WASHINGTON, D. C.

Vol. XXIV No. 3 PUBLISHED QUARTERLY SEPTEMBER, 1949

# Safety Record Improved in The National Crushed Stone Association Safety Competition of 1948

By E. K. ELSNER
A. N. GUINAN

Under Supervision of Forrest T. Moyer
Chief, Accident Analysis Branch
Economics and Statistics Division
U. S. Bureau of Mines
Washington, D. C.

THE Hagerstown quarry of the North American Cement Corporation at Hagerstown, Maryland won the top safety award in the 23rd annual National Crushed Stone Association Safety Competition conducted by the Bureau of Mines, United States Department of the Interior. This limestone quarry won the bronze plaque provided by the Explosives Engineer magazine for the outstanding accomplishment of operating 174,269 man-hours without a lost-time disabling injury during 1948. The Hagerstown quarry has been enrolled in the competition each year beginning with 1930. Although the trophy award in 1948 was its first, this operation achieved Certificates of Honorable Mention for accident-free operation in 8 other years of its 19-year history in the contest. It is notable that the Hagerstown quarry in its 19 years of participation in the competition attained a record of slightly more than 2 million hours with a severity rate of 0.46 days lost per 1,000 man-hours and a frequency rate of 8.40 injuries per 1,000,000 man-hours. From its 1948 achievement of top safety honors and the outstanding record of the past, it is fully evident that the employees and officials have worked diligently through the years to promote safe working practices and thereby eliminate accidents.

### Statistics of the Competition

Injury-experience of the 51 operations participating in the 1948 competition improved markedly over 1947 and also was better than the average for the 23 years of the contest. The injury-severity rate 4.763 days lost per 1,000 hours of work in 1948 was reduced to approximately half that of the preceding year. Likewise it was 18 per cent lower than the average severity experience of 5.817 since the competition was started in 1926. Injury-frequency of 26.857 per 1,000,000 man-hours in 1948 compared favorably with the corresponding rate of 29.287 for 1947, and was 14 per cent lower than the average frequency rate of 31.284 for the 23-year history of the competition.

The 51 operations enrolled in the 1948 National Crushed Stone Association Safety Competition were worked a total of 7,893,600 man-hours. During this work-time there were 212 injuries of which 4 were fatal, 11 permanent partial, and 197 temporary total injuries. The 4 fatals and the 11 permanent partial injuries occurred in the open quarry group. Average severity of the temporary total injuries at open quarries was 26 days lost per injury whereas at underground mines the average severity was 58 days per injury.

## TABLE I

### RELATIVE STANDING OF QUARRIES IN THE 1948 NATIONAL CRUSHED STONE ASSOCIATION SAFETY COMPETITION, BASED UPON THE INJURY SEVERITY RATES OF THE QUARRIES [1]

| Rank | Man-hours worked | Number of injuries [2] | | | | | Average days of disability per temp. injury | Number of days of disability [2] | | | | | Frequency rate [3] | Severity rate [3] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | F. | P.T. | P.P. | Temp. | Total | | F. | P.T. | P.P. | Temp. | Total | | |
| 1 | 174,269 | — | — | — | — | — | — | — | — | — | — | — | 0.000 | 0.000 |
| 3 | 118,158 | — | — | — | — | — | — | — | — | — | — | — | .000 | .000 |
| 4 | 100,344 | — | — | — | — | — | — | — | — | — | — | — | .000 | .000 |
| 5 | 72,248 | — | — | — | — | — | — | — | — | — | — | — | .000 | .000 |
| 6 | 55,502 | — | — | — | — | — | — | — | — | — | — | — | .000 | .000 |
| 7 | 51,092 | — | — | — | — | — | — | — | — | — | — | — | .000 | .000 |
| 8 | 48,960 | — | — | — | — | — | — | — | — | — | — | — | .000 | .000 |
| 9 | 41,250 | — | — | — | — | — | — | — | — | — | — | — | .000 | .000 |
| 10 | 11,520 | — | — | — | — | — | — | — | — | — | — | — | .000 | .000 |
| 11 | 48,236 | — | — | — | 1 | 1 | 1 | — | — | — | 1 | 1 | 20.731 | .021 |
| 12 | 462,924 | — | — | — | 1 | 1 | 35 | — | — | — | 35 | 35 | 2.160 | .076 |
| 14 | 190,427 | — | — | — | 2 | 2 | 11 | — | — | — | 21 | 21 | 10.503 | .110 |
| 15 | 284,607 | — | — | — | 4 | 4 | 9 | — | — | — | 36 | 36 | 14.054 | .126 |
| 16 | 97,395 | — | — | — | 2 | 2 | 7 | — | — | — | 13 | 13 | 20.535 | .133 |
| 17 | 95,959 | — | — | — | 1 | 1 | 26 | — | — | — | 26 | 26 | 10.421 | .271 |
| 18 | 37,932 | — | — | — | 1 | 1 | 13 | — | — | — | 13 | 13 | 26.349 | .343 |
| 19 | 65,310 | — | — | — | 3 | 3 | 10 | — | — | — | 31 | 31 | 45.935 | .475 |
| 20 | 639,078 | — | — | — | 4 | 4 | 77 | — | — | — | 306 | 306 | 6.259 | .479 |
| 21 | 66,768 | — | — | — | 1 | 1 | 32 | — | — | — | 32 | 32 | 14.977 | .479 |
| 22 | 99,377 | — | — | — | 3 | 3 | 18 | — | — | — | 55 | 55 | 30.188 | .553 |
| 23 | 108,450 | — | — | — | 5 | 5 | 13 | — | — | — | 67 | 67 | 46.104 | .618 |
| 24 | 162,150 | — | — | — | 8 | 8 | 13 | — | — | — | 104 | 104 | 49.337 | .641 |
| 25 | 666,065 | — | — | — | 34 | 34 | 13 | — | — | — | 433 | 433 | 51.046 | .650 |
| 26 | 135,026 | — | — | 1 | 2 | 3 | 12 | — | — | 75 | 24 | 99 | 22.218 | .733 |
| 27 | 178,900 | — | — | — | 9 | 9 | 15 | — | — | — | 135 | 135 | 50.307 | .755 |
| 28 | 41,600 | — | — | — | 3 | 3 | 11 | — | — | — | 33 | 33 | 72.115 | .793 |
| 30 | 75,204 | — | — | — | 2 | 2 | 31 | — | — | — | 61 | 61 | 26.594 | .811 |
| 31 | 247,837 | — | — | — | 7 | 7 | 29 | — | — | — | 205 | 205 | 28.244 | .827 |
| 32 | 149,728 | — | — | — | 7 | 7 | 25 | — | — | — | 172 | 172 | 46.751 | 1.149 |
| 33 | 66,681 | — | — | — | 6 | 6 | 15 | — | — | — | 88 | 88 | 89.981 | 1.320 |
| 34 | 112,038 | — | — | — | 8 | 8 | 19 | — | — | — | 154 | 154 | 71.404 | 1.375 |
| 35 | 43,171 | — | — | 1 | — | 1 | — | — | — | 75 | — | 75 | 23.164 | 1.737 |
| 36 | 253,620 | — | — | 2 | 11 | 13 | 28 | — | — | 150 | 311 | 461 | 51.258 | 1.818 |
| 38 | 47,659 | — | — | — | 2 | 2 | 44 | — | — | — | 88 | 88 | 41.965 | 1.846 |
| 39 | 42,120 | — | — | — | 1 | 1 | 79 | — | — | — | 79 | 79 | 23.742 | 1.876 |
| 40 | 99,080 | — | — | — | 1 | 1 | 192 | — | — | — | 192 | 192 | 10.093 | 1.938 |
| 41 | 68,128 | — | — | — | 1 | 1 | 158 | — | — | — | 158 | 158 | 14.678 | 2.319 |
| 42 | 123,192 | — | — | — | 14 | 14 | 27 | — | — | — | 383 | 383 | 113.644 | 3.109 |
| 43 | 298,655 | — | — | 4 | 10 | 14 | 12 | — | — | 855 | 124 | 979 | 46.877 | 3.278 |
| 44 | 166,348 | — | — | 1 | 1 | 2 | 4 | — | — | 563 | 4 | 567 | 12.023 | 3.409 |
| 45 | 318,887 | — | — | 1 | 6 | 7 | 28 | — | — | 1,800 | 169 | 1,969 | 21.951 | 6.175 |
| 46 | 48,151 | — | — | — | 1 | 1 | 447 | — | — | — | 447 | 447 | 20.768 | 9.283 |
| 47 | 304,044 | 1 | — | — | 10 | 11 | 44 | 6,000 | — | — | 442 | 6,442 | 36.179 | 21.188 |
| 48 | 162,135 | — | — | 1 | 2 | 3 | 33 | — | — | 4,500 | 66 | 4,566 | 18.503 | 28.162 |
| 49 | 102,880 | 1 | — | — | — | 1 | — | 6,000 | — | — | — | 6,000 | 9.720 | 58.320 |
| 50 | 85,808 | 1 | — | — | 1 | 2 | 4 | 6,000 | — | — | 4 | 6,004 | 23.308 | 69.970 |
| 51 | 84,636 | 1 | — | — | 6 | 7 | 22 | 6,000 | — | — | 130 | 6,130 | 82.707 | 72.428 |
| Totals and rates, 1948 | 6,953,569 | 4 | — | 11 | 181 | 196 | 26 | 24,000 | — | 8,018 | 4,642 | 36,660 | 28.187 | 5.272 |
| 1947 | 6,971,790 | 5 | — | 5 | 197 | 207 | 25 | 30,000 | — | 6,900 | 4,990 | 41,890 | 29.691 | 6.008 |

[1] As reports from mining companies are considered confidential by the Bureau of Mines, the identities of the operations to which this table relates are not revealed.

[2] F., fatal; P.T., permanent total disability; P.P., permanent partial disability; Temp., temporary disability.

[3] Frequency rate indicates the number of fatal, permanent, and other disabling injuries per million man-hours of exposure; severity rate indicates number of days of disability lost from injuries per thousand man-hours of exposure.

TABLE II

RELATIVE STANDING OF UNDERGROUND MINES IN THE 1948 NATIONAL CRUSHED STONE ASSOCIATION SAFETY COMPETITION, BASED UPON THE INJURY SEVERITY RATES OF THE MINES [1]

| Rank of plant | Man-hours worked | Number of injuries [1] | | | | | Average days of disability per temp. injury | Number of days of disability [1] | | | | | Frequency rate [1] | Severity rate [1] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | F. | P.T. | P.P. | Temp. | Total | | F. | P.T. | P.P. | Temp. | Total | | |
| 2 | 120,624 | — | — | — | — | — | — | — | — | — | — | — | 0.000 | 0.000 |
| 13 | 143,934 | — | — | — | 2 | 2 | 6 | — | — | — | 12 | 12 | 13.895 | .083 |
| 29 | 305,760 | — | — | — | 2 | 2 | 123 | — | — | — | 246 | 246 | 6.541 | .805 |
| 37 | 369,713 | — | — | — | 12 | 12 | 56 | — | — | — | 677 | 677 | 32.458 | 1.831 |
| Totals and rates, 1948 | 940,031 | — | — | — | 16 | 16 | 58 | — | — | — | 935 | 935 | 17.021 | .995 |
| 1947 | 1,291,162 | 5 | — | 1 | 29 | 35 | 55 | 30,000 | — | 75 | 1,588 | 31,663 | 27.107 | 24.523 |

[1] See footnotes 1, 2, and 3, Table I.

TABLE III

YEARLY SUMMARY—QUARRIES IN THE NATIONAL CRUSHED STONE ASSOCIATION SAFETY COMPETITION, 1926–48 [1]

| Year | Plants | Man-hours worked | Number of injuries [1] | | | | | Number of days of disability [1] | | | | | Frequency rate [1] | Severity rate [1] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Fatal | P.T. | P.P. | Temp. | Total | Fatal | P.T. | P.P. | Temp. | Total | | |
| 1926 | 40 | 5,298,983 | 3 | — | 6 | 207 | 216 | 18,000 | — | 9,000 | 4,239 | 31,239 | 40.763 | 5.895 |
| 1927 | 48 | 7,876,791 | 9 | — | 2 | 458 | 469 | 54,000 | — | 2,100 | 7,186 | 63,286 | 59.542 | 8.034 |
| 1928 | 53 | 7,509,098 | 8 | — | 4 | 322 | 334 | 48,000 | — | 8,700 | 5,493 | 62,193 | 44.479 | 8.282 |
| 1929 | 53 | 7,970,325 | 4 | — | 5 | 286 | 295 | 24,000 | — | 5,760 | 5,533 | 35,293 | 37.012 | 4.428 |
| 1930 | 68 | 8,013,415 | 6 | — | 9 | 227 | 242 | 36,000 | — | 7,250 | 3,671 | 46,921 | 30.199 | 5.855 |
| 1931 | 58 | 5,085,857 | 4 | — | 13 | 198 | 215 | 24,000 | — | 18,660 | 3,540 | 46,200 | 42.274 | 9.084 |
| 1932 | 40 | 2,661,850 | 1 | — | 4 | 75 | 80 | 6,000 | — | 6,750 | 2,481 | 15,231 | 30.054 | 5.722 |
| 1933 | 40 | 2,704,871 | 1 | — | 1 | 67 | 69 | 6,000 | — | 48 | 2,893 | 8,941 | 25.510 | 3.306 |
| 1934 | 46 | 3,288,257 | 1 | — | 2 | 106 | 109 | 6,000 | — | 2,850 | 1,873 | 10,723 | 33.148 | 3.261 |
| 1935 | 46 | 4,166,306 | 2 | 1 | 8 | 77 | 88 | 12,000 | 6,000 | 9,900 | 3,015 | 30,915 | 21.122 | 7.420 |
| 1936 | 50 | 6,399,023 | 5 | — | 14 | 182 | 201 | 30,000 | — | 8,168 | 4,590 | 42,758 | 31.411 | 6.682 |
| 1937 | 47 | 6,199,001 | 7 | — | 9 | 136 | 152 | 42,000 | — | 5,875 | 4,461 | 52,336 | 24.520 | 8.443 |
| 1938 | 47 | 4,658,119 | 2 | — | 6 | 76 | 84 | 12,000 | — | 6,600 | 3,184 | 21,784 | 18.033 | 4.677 |
| 1939 | 44 | 4,219,086 | 2 | — | 2 | 51 | 55 | 12,000 | — | 4,800 | 1,678 | 18,478 | 13.036 | 4.380 |
| 1940 | 46 | 4,358,409 | 1 | — | 5 | 78 | 84 | 6,000 | — | 2,550 | 3,013 | 11,563 | 19.273 | 2.653 |
| 1941 | 47 | 5,777,587 | 3 | — | 5 | 98 | 106 | 18,000 | — | 9,300 | 2,266 | 29,566 | 18.347 | 5.117 |
| 1942 | 48 | 7,178,935 | 3 | 2 | 1 | 183 | 189 | 18,000 | 12,000 | 1,500 | 4,239 | 35,739 | 26.327 | 4.978 |
| 1943 | 34 | 4,750,314 | 4 | — | 5 | 134 | 143 | 24,000 | — | 7,146 | 3,862 | 35,008 | 30.103 | 7.370 |
| 1944 | 32 | 3,996,433 | 3 | — | 4 | 118 | 125 | 18,000 | — | 3,000 | 3,323 | 24,323 | 31.278 | 6.086 |
| 1945 | 46 | 6,087,037 | — | — | 1 | 135 | 136 | — | — | 750 | 3,505 | 4,255 | 22.343 | 0.699 |
| 1946 | 46 | 7,292,175 | 1 | — | 6 | 197 | 204 | 6,000 | — | 5,141 | 4,130 | 15,271 | 27.975 | 2.094 |
| 1947 | 42 | 6,971,790 | 5 | — | 5 | 197 | 207 | 30,000 | — | 6,900 | 4,990 | 41,890 | 29.691 | 6.008 |
| 1948 | 47 | 6,953,569 | 4 | — | 11 | 181 | 196 | 24,000 | — | 8,018 | 4,642 | 36,660 | 28.187 | 5.272 |
| Total | — | 129,417,231 | 79 | 3 | 128 | 3,789 | 3,999 | 474,000 | 18,000 | 140,766 | 87,807 | 720,573 | 30.900 | 5.568 |

[1] See footnotes 1, 2, and 3, Table I.

TABLE IV

YEARLY SUMMARY—UNDERGROUND MINES IN THE NATIONAL CRUSHED STONE ASSOCIATION SAFETY COMPETITION, 1926–48 [1]

| Year | Plants | Man-hours worked | Number of injuries [1] | | | | | Number of days of disability [1] | | | | | Frequency rate [1] | Severity rate [1] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Fatal | P.T. | P.P. | Temp. | Total | Fatal | P.T. | P.P. | Temp. | Total | | |
| 1926 | 3 | 517,926 | — | — | — | 34 | 34 | — | — | — | 533 | 533 | 65.646 | 1.029 |
| 1927 | 2 | 318,449 | 1 | — | 1 | 14 | 16 | 6,000 | — | 300 | 68 | 6,368 | 50.244 | 19.997 |
| 1928 | 5 | 542,193 | 1 | — | 1 | 68 | 70 | 6,000 | — | 300 | 888 | 7,188 | 129.105 | 13.257 |
| 1929 | 4 | 665,520 | 1 | — | 1 | 30 | 32 | 6,000 | — | 300 | 617 | 6,917 | 48.083 | 10.393 |
| 1930 | 6 | 595,367 | 1 | — | 1 | 15 | 17 | 6,000 | — | 225 | 468 | 6,693 | 28.554 | 11.242 |
| 1931 | 3 | 345,105 | — | — | — | 4 | 4 | — | — | — | 147 | 147 | 11.591 | .426 |
| 1932 | 2 | 158,450 | — | — | — | 6 | 6 | — | — | — | 165 | 165 | 37.867 | 1.041 |
| 1933 | 3 | 229,381 | — | — | — | 11 | 11 | — | — | — | 349 | 349 | 47.955 | 1.521 |
| 1934 | 4 | 248,146 | — | — | — | 13 | 13 | — | — | — | 287 | 287 | 52.389 | 1.157 |
| 1935 | 2 | 175,994 | — | — | — | 3 | 3 | — | — | — | 249 | 249 | 17.046 | 1.415 |
| 1936 | 4 | 334,747 | 1 | — | — | 7 | 8 | 6,000 | — | — | 117 | 6,117 | 23.899 | 18.274 |
| 1937 | 3 | 364,680 | — | — | — | 3 | 3 | — | — | — | 91 | 91 | 8.226 | .250 |
| 1938 | 3 | 334,442 | — | — | — | 2 | 2 | — | — | — | 133 | 133 | 5.980 | .398 |
| 1939 | 4 | 393,039 | — | — | 1 | 7 | 8 | — | — | 600 | 457 | 1,057 | 20.354 | 2.689 |
| 1940 | 4 | 375,987 | — | — | 1 | 8 | 9 | — | — | 4,500 | 888 | 5,388 | 23.737 | 14.330 |
| 1941 | 4 | 591,568 | — | — | 1 | 15 | 16 | — | — | 750 | 169 | 919 | 27.047 | 1.553 |
| 1942 | 4 | 785,894 | — | — | 1 | 33 | 34 | — | — | 1,800 | 1,213 | 3,013 | 43.263 | 3.834 |
| 1943 | 5 | 1,019,771 | — | — | 3 | 45 | 48 | — | — | 4,950 | 1,123 | 6,073 | 47.069 | 5.955 |
| 1944 | 4 | 727,496 | 1 | — | 1 | 27 | 29 | 6,000 | — | 2,400 | 796 | 9,196 | 39.863 | 12.641 |
| 1945 | 7 | 1,238,845 | — | — | 2 | 22 | 24 | — | — | 3,000 | 755 | 3,755 | 19.373 | 3.031 |
| 1946 | 8 | 1,338,563 | 2 | — | 2 | 31 | 35 | 12,000 | — | 675 | 1,045 | 13,720 | 26.147 | 10.250 |
| 1947 | 8 | 1,291,162 | 5 | — | 1 | 29 | 35 | 30,000 | — | 75 | 1,588 | 31,663 | 27.107 | 24.523 |
| 1948 | 4 | 940,031 | — | — | — | 16 | 16 | — | — | — | 935 | 935 | 17.021 | .995 |
| Total | — | 13,532,756 | 13 | — | 17 | 443 | 473 | 78,000 | — | 19,875 | 13,081 | 110,956 | 34.952 | 8.199 |

[1] See footnotes 1, 2, and 3, Table I.

TABLE V

YEARLY SUMMARY—QUARRIES AND UNDERGROUND MINES IN THE NATIONAL CRUSHED STONE ASSOCIATION SAFETY COMPETITION, 1926–48 [1]

| Year | Plants | Man-hours worked | Number of injuries [1] | | | | | Number of days of disability [1] | | | | | Frequency rate [1] | Severity rate [1] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Fatal | P.T. | P.P. | Temp. | Total | Fatal | P.T. | P.P. | Temp. | Total | | |
| 1926 | 43 | 5,816,909 | 3 | — | 6 | 241 | 250 | 18,000 | — | 9,000 | 4,772 | 31,772 | 42.978 | 5.462 |
| 1927 | 50 | 8,195,240 | 10 | — | 3 | 472 | 485 | 60,000 | — | 2,400 | 7,254 | 69,654 | 59.181 | 8.499 |
| 1928 | 58 | 8,051,291 | 9 | — | 5 | 390 | 404 | 54,000 | — | 9,000 | 6,381 | 69,381 | 50.178 | 8.617 |
| 1929 | 57 | 8,635,845 | 5 | — | 6 | 316 | 327 | 30,000 | — | 6,060 | 6,150 | 42,210 | 37.865 | 4.888 |
| 1930 | 74 | 8,608,782 | 7 | — | 10 | 242 | 259 | 42,000 | — | 7,475 | 4,139 | 53,614 | 30.086 | 6.228 |
| 1931 | 61 | 5,430,962 | 4 | — | 13 | 202 | 219 | 24,000 | — | 18,660 | 3,687 | 46,347 | 40.324 | 8.534 |
| 1932 | 42 | 2,820,300 | 1 | — | 4 | 81 | 86 | 6,000 | — | 6,750 | 2,646 | 15,396 | 30.493 | 5.459 |
| 1933 | 43 | 2,934,252 | 1 | — | 1 | 78 | 80 | 6,000 | — | 48 | 3,242 | 9,290 | 27.264 | 3.166 |
| 1934 | 50 | 3,536,403 | 1 | — | 2 | 119 | 122 | 6,000 | — | 2,850 | 2,160 | 11,010 | 34.498 | 3.113 |
| 1935 | 48 | 4,342,300 | 2 | 1 | 8 | 80 | 91 | 12,000 | 6,000 | 9,900 | 3,264 | 31,164 | 20.957 | 7.177 |
| 1936 | 54 | 6,733,770 | 6 | — | 14 | 189 | 209 | 36,000 | — | 8,168 | 4,707 | 48,875 | 31.038 | 7.258 |
| 1937 | 50 | 6,563,681 | 7 | — | 9 | 139 | 155 | 42,000 | — | 5,875 | 4,552 | 52,427 | 23.615 | 7.987 |
| 1938 | 50 | 4,992,561 | 2 | — | 6 | 78 | 86 | 12,000 | — | 6,600 | 3,317 | 21,917 | 17.226 | 4.390 |
| 1939 | 48 | 4,612,125 | 2 | — | 3 | 58 | 63 | 12,000 | — | 5,400 | 2,135 | 19,535 | 13.660 | 4.236 |
| 1940 | 50 | 4,734,396 | 1 | — | 6 | 86 | 93 | 6,000 | — | 7,050 | 3,901 | 16,951 | 19.643 | 3.580 |
| 1941 | 51 | 6,369,155 | 3 | — | 6 | 113 | 122 | 18,000 | — | 10,050 | 2,435 | 30,485 | 19.155 | 4.786 |
| 1942 | 52 | 7,964,829 | 3 | 2 | 2 | 216 | 223 | 18,000 | 12,000 | 3,300 | 5,452 | 38,752 | 27.998 | 4.865 |
| 1943 | 39 | 5,770,085 | 4 | — | 8 | 179 | 191 | 24,000 | — | 12,096 | 4,985 | 41,081 | 33.102 | 7.120 |
| 1944 | 36 | 4,723,929 | 4 | — | 5 | 145 | 154 | 24,000 | — | 5,400 | 4,119 | 33,519 | 32.600 | 7.096 |
| 1945 | 53 | 7,325,882 | — | — | 3 | 157 | 160 | — | — | 3,750 | 4,260 | 8,010 | 21.840 | 1.093 |
| 1946 | 54 | 8,630,738 | 3 | — | 8 | 228 | 239 | 18,000 | — | 5,816 | 5,175 | 28,991 | 27.692 | 3.359 |
| 1947 | 50 | 8,262,952 | 10 | — | 6 | 226 | 242 | 60,000 | — | 6,975 | 6,578 | 73,553 | 29.287 | 8.902 |
| 1948 | 51 | 7,893,600 | 4 | — | 11 | 197 | 212 | 24,000 | — | 8,018 | 5,577 | 37,595 | 26.857 | 4.763 |
| Total | — | 142,949,987 | 92 | 3 | 145 | 4,232 | 4,472 | 552,000 | 18,000 | 160,641 | 100,888 | 831,529 | 31.284 | 5.817 |

[1] See footnotes 1, 2, and 3, Table I.

The improvement in the over-all safety record of the 1948 contest resulted primarily from the outstanding record of the 4 underground mines enrolled. At these mines there were 16 temporary total injuries which caused a loss of 935 days. The resulting severity rate of 0.995 and frequency of 17.021 were respectively the fourth lowest annual rates in the competition's history. Although the 47 competing quarries compiled a safety record that was better than in 1947, the degree of improvement was not as marked as at the underground operations.

### Injury-Free Operations

The following 9 plants—8 open quarries and 1 underground mine attained injury-free records in 1948 and received Certificates of Honorable Mention. Including the trophy winner, the 10 injury-free operations were worked a total of 793,967 man-hours. Such accomplishments show clearly what can be achieved by persistent efforts in accident prevention work.

Bakerton limestone mine, The Standard Lime and Stone Company, Bakerton, Jefferson County, West Virginia; 120,624 man-hours.

Leroy limestone quarry, The General Crushed Stone Company, LeRoy, Genesee County, New York; 118,158 man-hours.

White Haven sandstone quarry, The General Crushed Stone Company, White Haven, Luzerne County, Pennsylvania; 100,344 man-hours.

Winchester trap rock quarry, The General Crushed Stone Company, Winchester, Middlesex County, Massachusetts; 72,248 man-hours.

Marquette limestone quarry, Marquette Cement Manufacturing Company, Cape Girardeau, Cape Girardeau County, Missouri; 55,502 man-hours.

Middlefield No. 1 trap rock quarry, New Haven Trap Rock Company, Middlefield, New Haven County, Connecticut; 51,092 man-hours.

Macedonia limestone and road rock quarry, Missouri Valley Limestone Company, Inc., Macedonia, Pottawattamie County, Iowa; 48,960 man-hours.

Newton limestone quarry, Waterloo Dredging Company, Waterloo, Black Hawk County, Iowa; 41,250 man-hours.

Avoca limestone quarry, Jefferson County Stone Company, Anchorage, Jefferson County, Kentucky; 11,520 man-hours.

### The Competition

The winning plant in the annual National Crushed Stone Association Safety Competition is awarded a bronze plaque on which is portrayed in bas-relief the quarry scene on the pedestal of the "Sentinels of Safety" trophy awarded in the National Safety Competition. The plaque is furnished by the Explosives Engineer magazine. Each plant in the contest, except the winner, that operated throughout the year without a lost-time injury is given an honorable mention award of a parchment certificate which is a reproduction of the bronze plaque. In addition, each employee of an accident-free plant is presented with a Certificate of Honor.

This annual Competition for the promotion of safety in the crushed stone industry is conducted under the same rules as the National Safety Competition and the same records are used in both contests. There are two additional qualifications for the crushed stone competition which are that the operation must have commercial production of crushed stone and that the company be a member of the Association. Of the 509 enrolled operations in the 1948 National Safety Competition, 51 were eligible for participation in the competition.

The following 18 states were represented in the 1948 contest:

| States | No. of plants | States | No. of plants | States | No. of plants |
|---|---|---|---|---|---|
| Connecticut | 3 | Massachusetts | 1 | Oklahoma | 1 |
| Georgia | 1 | Michigan | 2 | Pennsylvania | 10 |
| Illinois | 1 | Missouri | 2 | Tennessee | 1 |
| Iowa | 3 | New Jersey | 1 | Texas | 2 |
| Kentucky | 2 | New York | 12 | Virginia | 2 |
| Maryland | 2 | Ohio | 1 | West Virginia | 4 |

Forty operations enrolled in the 1948 Competition were also enrolled in 1947. Two of these operations had accident-free records in both years; 20 had better severity rates and 18 had worse severity rates in 1948. The following is a comparison of these identical plants. It is noteworthy that the severity rate at identical plants in 1948 was slightly less than half that of 1947.

| Year | Man-hours worked | Total number of injuries | Total number of days of disability | Frequency rate | Severity rate |
|---|---|---|---|---|---|
| 1947 | 7,384,656 | 204 | 54,500 | 27.625 | 7.380 |
| 1948 | 7,176,799 | 184 | 25,128 | 25.638 | 3.501 |

| Year | Number of injuries | | | | | Number of days of disability | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | F. | P.T. | P.P. | Temp. | Total | F. | P.T. | P.P. | Temp. | Total |
| 1947 | 7 | ..... | 5 | 192 | 204 | 42,000 | ..... | 6,900 | 5,600 | 54,500 |
| 1948 | 2 | ..... | 11 | 171 | 184 | 12,000 | ..... | 8,018 | 5,110 | 25,128 |

### Cause of Injuries

Fifty-four per cent of the injuries for which causes were given at the 51 crushed stone operations resulted from handling materials or objects, falls of

TABLE VI

NUMBER OF INJURIES, BY CAUSES, AT QUARRIES AND UNDERGROUND MINES IN THE NATIONAL CRUSHED STONE ASSOCIATION SAFETY COMPETITION IN 1948

| Cause | Fatal | Permanent | | Tempo-rary | Total |
|---|---|---|---|---|---|
| | | Total | Partial | | |
| Falls and slides of rock or materials | — | — | 1 | 11 | 12 |
| Handling materials or objects | — | — | 5 | 31 | 36 |
| Hand tools | — | — | 2 | 17 | 19 |
| Explosives | — | — | — | 1 | 1 |
| Haulage | 3 | — | 1 | 23 | 27 |
| Falls of persons | — | — | — | 31 | 31 |
| Bumping against objects | — | — | — | 3 | 3 |
| Falling objects | — | — | 1 | 5 | 6 |
| Flying objects or particles | — | — | — | 2 | 2 |
| Electricity | — | — | — | 2 | 2 |
| Drilling | — | — | — | 10 | 10 |
| Machinery | 1 | — | 1 | 11 | 13 |
| Stepping on objects | — | — | — | 5 | 5 |
| Burns | — | — | — | 3 | 3 |
| Other causes | — | — | — | 4 | 4 |
| Total | 4 | — | 11 | 159 | 174 |
| Not stated | — | — | — | 38 | 38 |
| Grand total | 4 | — | 11 | 197 | 212 |

TABLE VII

DAYS OF DISABILITY BY CAUSES OF INJURIES AT QUARRIES AND UNDERGROUND MINES IN THE NATIONAL CRUSHED STONE ASSOCIATION SAFETY COMPETITION IN 1948

| Cause | Fatal | Permanent | | Tempo-rary | Total |
|---|---|---|---|---|---|
| | | Total | Partial | | |
| Falls and slides of rock or materials | — | — | 4,500 | 1,231 | 5,731 |
| Handling materials or objects | — | — | 1,343 | 822 | 2,165 |
| Hand tools | — | — | 1,920 | 408 | 2,328 |
| Explosives | — | — | — | 29 | 29 |
| Haulage | 18,000 | — | 150 | 686 | 18,836 |
| Falls of persons | — | — | — | 1,130 | 1,130 |
| Bumping against objects | — | — | — | 68 | 68 |
| Falling objects | — | — | 75 | 68 | 143 |
| Flying objects or particles | — | — | — | 12 | 12 |
| Electricity | — | — | — | 3 | 3 |
| Drilling | — | — | — | 218 | 218 |
| Machinery | 6,000 | — | 30 | 203 | 6,233 |
| Stepping on objects | — | — | — | 106 | 106 |
| Burns | — | — | — | 67 | 67 |
| Other causes | — | — | — | 53 | 53 |
| Total | 24,000 | — | 8,018 | 5,104 | 37,122 |
| Not stated | — | — | — | 473 | 473 |
| Grand total | 24,000 | — | 8,018 | 5,577 | 37,595 |

TABLE VIII

AVERAGE DAYS OF DISABILITY PER TEMPORARY INJURY AT PLANTS ENROLLED IN THE NATIONAL CRUSHED STONE ASSOCIATION SAFETY COMPETITION

| Year | Underground mines | | | Open Quarries | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|
| | No. of temporary injuries | No. of days of disability | Average days of disability | No. of temporary injuries | No. of days of disability | Average days of disability | No. of temporary injuries | No. of days of disability | Average days of disability |
| 1926 | 34 | 533 | 16 | 207 | 4,239 | 20 | 241 | 4,772 | 20 |
| 1927 | 14 | 68 | 5 | 458 | 7,186 | 16 | 472 | 7,254 | 15 |
| 1928 | 68 | 888 | 13 | 322 | 5,493 | 17 | 390 | 6,381 | 16 |
| 1929 | 30 | 617 | 21 | 286 | 5,533 | 19 | 316 | 6,150 | 19 |
| 1930 | 15 | 468 | 31 | 227 | 3,671 | 16 | 242 | 4,139 | 17 |
| 1931 | 4 | 147 | 37 | 198 | 3,540 | 18 | 202 | 3,687 | 18 |
| 1932 | 6 | 165 | 28 | 75 | 2,481 | 33 | 81 | 2,646 | 33 |
| 1933 | 11 | 349 | 32 | 67 | 2,893 | 43 | 78 | 3,242 | 42 |
| 1934 | 13 | 287 | 22 | 106 | 1,873 | 18 | 119 | 2,160 | 18 |
| 1935 | 3 | 249 | 83 | 77 | 3,015 | 39 | 80 | 3,264 | 41 |
| 1936 | 7 | 117 | 17 | 182 | 4,590 | 25 | 189 | 4,707 | 25 |
| 1937 | 3 | 91 | 30 | 136 | 4,461 | 33 | 139 | 4,552 | 33 |
| 1938 | 2 | 133 | 67 | 76 | 3,184 | 42 | 78 | 3,317 | 43 |
| 1939 | 7 | 457 | 65 | 51 | 1,678 | 33 | 58 | 2,135 | 37 |
| 1940 | 8 | 888 | 111 | 78 | 3,013 | 39 | 86 | 3,901 | 45 |
| 1941 | 15 | 169 | 11 | 98 | 2,266 | 23 | 113 | 2,435 | 22 |
| 1942 | 33 | 1,213 | 37 | 183 | 4,239 | 23 | 216 | 5,452 | 25 |
| 1943 | 45 | 1,123 | 25 | 134 | 3,862 | 29 | 179 | 4,985 | 28 |
| 1944 | 27 | 796 | 29 | 118 | 3,323 | 28 | 145 | 4,119 | 28 |
| 1945 | 22 | 755 | 34 | 135 | 3,505 | 26 | 157 | 4,260 | 27 |
| 1946 | 31 | 1,045 | 34 | 228 | 5,175 | 23 | 259 | 6,220 | 24 |
| 1947 | 29 | 1,588 | 55 | 197 | 4,990 | 25 | 226 | 6,578 | 29 |
| 1948 | 16 | 935 | 58 | 181 | 4,642 | 26 | 197 | 5,577 | 28 |
| Total | 443 | 13,081 | 30 | 3,820 | 88,852 | 23 | 4,263 | 101,933 | 24 |

persons and haulage, as shown in Table VI. Hand tools, machinery, falls and slides of rock or materials and drilling were the succeeding most frequent causes of disabling injuries. Haulage, machinery, and falls and slides of rock or material accounted for 83 per cent of the days of disability.

### Summary of Tables

Tables I and II show the relative standing of the open quarries and underground mines, arranged in ascending order of accident-severity rates of the plants. When two or more plants have accident-free records, the number of man-hours governs the order. Tables III and IV show yearly summary figures from 1926 to 1948. Table V shows a yearly combined summary of open quarries and underground mines in the Competition. The number of injuries by causes and the days of disability by causes of injuries are shown in Tables VI and VII. Table VIII gives the average days of disability for temporary injuries at mines and quarries enrolled in the contest. Table IX gives employment and accident data for crushed stone plants enrolled in the National Crushed Stone Association Safety Competition, 1947 and 1948, covering identical plants for both years and plants enrolled only in 1947 and 1948.

TABLE IX

EMPLOYMENT AND INJURY DATA FOR CRUSHED STONE PLANTS ENROLLED IN THE NATIONAL CRUSHED STONE ASSOCIATION SAFETY COMPETITION, 1947 AND 1948, COVERING IDENTICAL PLANTS FOR BOTH YEARS AND PLANTS ENROLLED ONLY IN 1947 OR IN 1948

| | No. | Man-hours worked | Number of injuries [1] | | | | | Days of disability [1] | | | | | Frequency rate [1] | Severity rate [1] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | F. | P.T. | P.P. | Temp. | Total | F. | P.T. | P.P. | Temp. | Total | | |
| Plants enrolled in 1947 only..... | 10 | 878,296 | 3 | — | 1 | 34 | 38 | 18,000 | — | 75 | 978 | 19,053 | 43.266 | 21.693 |
| Identical plants enrolled both years, 1947..... | 40 | 7,384,656 | 7 | — | 5 | 192 | 204 | 42,000 | — | 6,900 | 5,600 | 54,500 | 27.625 | 7.380 |
| Identical plants enrolled both years, 1948..... | 40 | 7,176,799 | 2 | — | 11 | 171 | 184 | 12,000 | — | 8,018 | 5,110 | 25,128 | 25.638 | 3.501 |
| Plants enrolled in 1948 only..... | 11 | 716,801 | 2 | — | — | 26 | 28 | 12,000 | — | — | 467 | 12,467 | 39.062 | 17.393 |

[1] See footnotes 1, 2, and 3 in Table I.

# Highway Contracts Reach $647,485,000

HIGHWAY improvements costing approximately $647,485,000 for construction were let to contract by state highway departments during the first seven months of this year, according to reports received by the Bureau of Public Roads of the U. S. Department of Commerce. The projects involved work on 25,828 miles of road.

These figures were slightly lower than the $684,560,000 worth of construction work on 26,470 miles of roadway for which contracts were awarded between January 1 and August 1 of last year.

Contract awards in July of this year totaled $123,151,000 for improvements on 4,376 miles of highway, as compared with a total of $116,469,000 for 4,756 miles of road work in July a year ago.

Projects financed partially or entirely with federal funds accounted for $389,504,000 of the total cost of road work contracted for during the past seven months. The federal contribution amounted to $208,578,000. The contract cost of projects financed without federal aid was $257,981,000.

Pennsylvania, with a total of $69,236,000, led the states in the dollar-volume of contracts let in the seven-month period. New York was second with a total of $60,751,000. Texas was third with a total of $57,405,000, and California fourth with a total of $38,136,000.

In total mileage of road improvements contracted for, Texas was first with 3,688 miles; Ohio second, with 2,305 miles; Kentucky third, with 2,044 miles; Kansas fourth, with 1,251 miles, and Pennsylvania fifth, with 1,129 miles. Federal-aid projects completed during the first seven months of this year consisted of improvements on 6,815 miles in the federal-aid primary and secondary road systems at a total cost of $279,477,000, of which $140,209,000 was federal funds.

# Traffic Bound Roads

**By JOSEPH E. GRAY**

**Field Engineer**
**National Crushed Stone Association**
**Washington, D. C.**

WITH the rural road program gaining impetus, greater effort is being exerted by the various highway departments to build more miles of hard-surfaced, all-weather, dustless roads at a low cost. Generally speaking, the cheapest, all-weather, hard-surfaced roads are the traffic bound roads which are now being built under force account by the smallest highway organizations and under contract by state highway departments.

The traffic bound road is probably the oldest type of surfaced road. Not only is it the simplest to build but also, it possesses another advantage over other types in that weak areas in the subgrade are strengthened during the process of construction so that a surface of reasonably uniform load carrying capacity is developed. It consists essentially of a layer of aggregate (crushed stone, slag, or gravel) spread to a uniform thickness on a prepared subgrade. This layer is maintained by regular blading and traffic gradually compacts it from the subgrade upward. The surface is kept covered with a thin mulch of loose aggregate of the same materials as are in the body of the surface. A small, well-trained construction crew with trucks, aggregate spreader, and a blade grader can build these roads with remarkable facility. However, proper maintenance is the key to success with this particular type of construction.

In the 1920's when traffic bound roads were being built extensively and were widely publicized, the keynote in road building was "stage construction." The traffic bound road lent itself admirably to this principle of adding relatively small quantities of aggregate each year to build up thickness to meet the demands of traffic. However, in practice the results were often far from those anticipated, for the amount of stone added was so small that a great part of it was lost through wear before more metal was added. Also, the spring break-up took a high toll of road metal as the stone mixed with great quantities of mud and was lost as the mixture dried. The result was that the base thickness was not materially increased; and when such roads were given a bituminous surface treatment to alleviate the dust nuisance, they failed, because of an inadequate foundation course to transmit and distribute the traffic load over sufficient area of the subgrade.

The cost of rehabilitating such roads is disproportionately high and must be avoided. Thus, it is most important both from the standpoint of good engineering and economy to have a base course of adequate thickness before applying a bituminous surfacing.

It is the purpose of this paper to review what is believed to be the best practice and to point out certain critical features of construction and maintenance. It will be assumed that right-of-way, grade, alignment, and sight distance are satisfactory for the anticipated volume of traffic, and that necessary drainage has been provided. Our main concern is the development of an all-weather surface of sufficient thickness to carry the anticipated traffic loads at a low cost.

FIGURE 1
A Well-Built Traffic Bound Road. Note Dense Surface With Floating Cover Stone

## Primary Considerations in Traffic Bound Construction

In the past, the traffic bound road was considered primarily as a low-cost surfacing. It was a hard-surfaced, all-weather road but was dusty, potholed readily, required constant maintenance, and had a high yearly loss of road metal. Today, with modern, high-speed traffic and the public demand for a dust-

less surface, the traffic bound road is considered a relatively inexpensive method of building up a good base that can be given a light bituminous surface treatment and which will then be a hard-surfaced, all-weather, dustless road of adequate structural strength. Thus the traffic bound road should function as such only for a year or two in order to allow time to properly strengthen all weak places before it is given a surface treatment.

While the fundamental principles of traffic bound construction are quite simple, there is a basic difference in the properties of aggregates which requires different methods of construction. This basic difference is in the natural cementing properties of the aggregate. Some types of aggregate, notably the limestones, compact readily and cement themselves into a firm, stable base; whereas some other types of aggregate do not bind or form of themselves a well-cemented base. Since there are no satisfactory methods of measuring the compaction and cementing properties of aggregates, judgment of these properties should be based on the experience of the engineer with the materials proposed for use. Two methods of construction will be described—one for aggregates without natural cementing properties, and the other for aggregates with natural cementing properties.

FIGURE 2
Essential Heavy Equipment for Traffic Bound Construction—An Aggregate Spreader and a Blade Grader

### Aggregate Without Natural Cementing Properties

While, in general, little attention is paid to the soil characteristics of the subgrade, the existing road should be inspected for soils that have a tendency to heave and for locations of poor drainage. All heaving soils should be removed to below the frost line and replaced with suitable granular material. The subgrade should then be brought to a firm, uniform cross-section with a crown of 0 to 1/2 in. per ft. A flat cross-section or a low crown is used with sandy subgrades and a higher crown with clay subgrades.

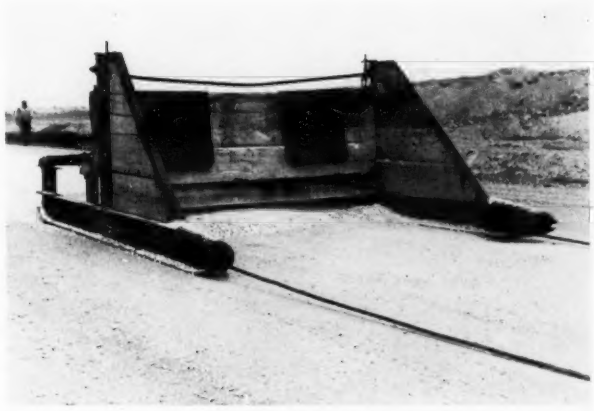

FIGURE 3
A Device for Spreading Aggregate to a Uniform Thickness Directly From Trucks

A method of construction that has been satisfactory is to spread the aggregate upon the prepared subgrade to a loose depth of 6 in. for the full width of the road. Then the top 4 in. of aggregate is bladed off the road into two windrows on the shoulders and the road is opened to traffic. As soon as the first 2 in. of aggregate is well bound, another 2-in. layer is bladed upon the road from the material stockpiled in the windrows. When this second layer is consolidated, the final 2 in. is spread and compacted by traffic. The result is a continuous building up of a full 6-in. course.

A gradation specification for the aggregate which has been used with good results is a follows:

| | | |
|---|---|---|
| Total per cent passing | 1 in. | 100 |
| | 3/4 in. | 95–100 |
| | 1/2 in. | 65–90 |
| | 3/8 in. | 35–65 |
| | No. 4 | 0–15 |

The binding of the aggregate with the subgrade soil takes place for the most part during the period following a rain when the soil is moist and some-

what plastic. When the subgrade is hard and dry, obviously, no binding of aggregate or building-up of compacted thickness can take place, so careful, continuous maintenance is essential to provide sufficient aggregate when the subgrade is moist and not too much aggregate when the subgrade is dry. In other words, with the subgrade moist, up to about

FIGURE 4
Aggregate Stockpiled in Windrows on the Shoulders Until the Moisture Conditions Are Right for Spreading

2 in. of loose aggregate should be on the road; if the subgrade is dry and hard, only a floating cover of about 1/2-in. thickness should be maintained.

### Aggregate With Natural Cementing Properties

The natural cementing portion of any aggregate is that passing the 200-mesh sieve. Therefore, road metal having natural cementing properties for this type of construction should be a crusher-run product including all of the dust of fracture. Even then, supplemental fines are often needed. These additional fines are generally created by the grinding action of traffic or they may be applied where needed.

A gradation specification for crushed stone that has given satisfactory results and is economical to produce is as follows:

| | | |
|---|---|---|
| Total per cent passing | 1 in. | 100 |
| | 1/2 in. | 60–90 |
| | No. 4 | 40–60 |
| | No. 16 | 20–40 |
| | No. 200 | 5–15 |

The construction procedure is to spread the stone on the prepared subgrade to the required thickness, either directly from trucks or through a spreader box. The thickness varies from 4 to 10 in. depending upon the intensity of traffic. Usually, trucks haul over the spread stone so that it is compacted to such a degree that the surface is not objectionable to normal traffic. If the application is heavy and the trucks do not compact it sufficiently, the excess loose material is bladed into windrows on the shoulder to be spread upon the road as the aggregate in place becomes consolidated. Again, proper maintenance is essential to building up a firm, stable, smooth-riding surface.

### Maintenance

Since proper maintenance in traffic bound construction is so important, a review of the fundamentals may be in order. Continual surface maintenance with a drag or blade maintainer is necessary to (a) encourage traffic to use the entire road surface, (b) to distribute the aggregate so that it can be bound, and (c) to prevent ruts and corrugations. A light, "floating cover" of aggregate should be on the road at all times. However, especially in dry weather, too heavy a cover is conducive to skid-

FIGURE 5
Traffic Bound Base With a 2-in. Plant Mix Bituminous Topping

ding. It is well established that an aggregate of 3/4-in. maximum size can be bladed easily without tearing the underlying, compacted surface. Blading is most effective when done immediately after a rain when the surface is moist. Also, the better practice in blading is to work completely across the road; that is, commence on the right side and go to the

left and on the subsequent operation, begin at the left side and work to the right. This is preferred to the old method of blading from each side to the center, thus leaving a wedge of loose aggregate that produces a false crown and is avoided by traffic.

The maintenance of a proper crown is most important. If the road has fairly level stretches with too flat a cross-section, all slight surface depressions will hold water. Then, under the action of traffic, the fines are soon forced into suspension and are washed away, leaving coarse aggregate without any binder. When dry, traffic soon throws out the loose aggregate causing a pothole. A 1/2 to 5/8 in. per ft. crown should be maintained at all times.

FIGURE 6
A Multiple Blade Drag for Maintaining Traffic Bound Roads

FIGURE 7
Effect of One Passage of Drag. Note Uniform Surface on Left Side of Road

If potholes should develop, they should be removed by local scarifying and the addition of material similar to that in the body of the road.

**Conclusions**

Since all weak spots in a traffic bound road are corrected through proper maintenance, it becomes an ideal base, if of adequate thickness, for a bituminous surfacing of whatever type the intensity of traffic warrants. Construction of this type is a good method for developing a satisfactory base, but it is essential that sufficient aggregate of the proper gradation be placed on the road initially to do the job expeditiously.

## BPR Goes Under Commerce Department

BY LAW now a part of the Commerce Department, the Bureau of Public Roads expects few actual changes to result from its shift, first from the Federal Works Agency and then from the new General Services Administration. The transfer to Commerce was ordered by President Truman under his reorganization powers, and a Senate attempt to keep the Roads Bureau under GSA failed by a 47 to 40 vote. The shift was effective August 19, and Secretary of Commerce Sawyer then issued an order ushering BPR into his department but keeping its physical setup the same. Commissioner Thomas H. MacDonald has paid a courtesy call at Commerce, as has Solicitor L. E. Boykin.

BPR is expected to keep its own offices a few blocks away from Commerce, as Commerce has no vacant space for it to occupy.

Public Works Committees of House and Senate expect to continue to be the Congressional contact groups with BPR. However, some changes may be made in Appropriations Committee machinery.

## Elastic Steel

Steel isn't as rigid as you might think. One oil company calculates that a 10,000-ft. length of steel pipe in a well may stretch as much as 5 ft. and, when the power is applied to rotate the drill-pipe, the top end will revolve at least 8 full turns before the drill at the bottom begins to move.

# W. E. Farrell

IT IS with deep regret and sincere sorrow that we announce the death of William Elliston Farrell, Founder and Chairman of the Easton Car and Construction Company, of Easton, Pennsylvania. Mr. Farrell passed away at St. Luke's Hospital, Bethlehem, Pennsylvania, on August 22, 1949, at the age of 79.

While famous throughout this country and Europe for his research in mine and quarry transportation, Mr. Farrell particularly enjoyed the affection and esteem of the crushed stone industry through his loyal and enthusiastic interest in the activities of the National Crushed Stone Association and its Manufacturers Division.

W. E. FARRELL
1870-1949

He had the distinction of being one of the six men who organized the Division at a meeting held on January 16, 1923, in Chicago, Illinois, during the 6th Annual Convention of the Association. At that time he was elected to the office of 2nd Vice Chairman and to the Board of Directors. Further honor was to be given him when at the Cincinnati Convention in January 1925, Mr. Farrell was elected Chairman of the Division to succeed its first Chairman, the late Nelson Greensfelder.

While the broadening scope of Mr. Farrell's activities and interests denied him the pleasure of close association with NCSA affairs during subsequent years, his continuing interest in the organization which he helped to establish and guide through its infant years was reflected by the following telegram sent to the Division on the occasion of its 25th Anniversary at the NCSA Annual Convention in 1948:

> "Accept my congratulations on this, your 25th Anniversary. I wish Mr. Greensfelder, who so ably conducted this organization and its successful growth, were privileged to observe it today. May the close and friendly relations between you and the National Crushed Stone Association grow in the future as it has in the past.
>
> "Sincerely,
>
> "W. E. FARRELL, *Chairman,*
> *"Easton Car and Construction Company"*

It seems appropriate to recall here that on this same occasion his son Cottrell Farrell was elected Chairman of the Manufacturers Division, a post filled by his father twenty-three years before.

Mr. Farrell started in business for himself in 1912, opening an office as a manufacturer's representative in Easton. A year later he purchased the manufacturing business of Ernst Weiner & Company, and in 1914 incorporated this business as the Easton Car & Construction Company. He served as President of his company until 1946, when he became its Chairman.

In 1920 Mr. Farrell engaged in a study of quarry haulage problems, an interest in which he remained active throughout his life. Many outstanding contributions toward the development of improved transportation methods in mines and quarries are attributed to his work in this field. Of major importance was his patented development of the revolutionary doorless two-way dumping pan (Phoenix Car) which is now used in many parts of the world. Later he pioneered the use of trucks and trailers in open-pit quarries, again featuring the pan body. During recent years, he published several articles concerning the history and development of power shovels, stone crushers, and industrial railroad equipment.

Mr. Farrell is survived by his widow, the former Emily Cottrell of Danville, Pennsylvania; one daughter, Mrs. Norman Stagg, of Ithaca, New York; and two sons: Cottrell, of Easton, Pennsylvania, and Elliston, of Long Beach, California.

# MANUFACTURERS DIVISION

# NATIONAL CRUSHED STONE ASSOCIATION

**These associate members are morally and financially aiding the Association in its efforts to protect and advance the interests of the crushed stone industry. Please give them favorable consideration whenever possible.**

**Allis-Chalmers Mfg. Co.**
Milwaukee 1, Wis.
*Crushing, Screening, Washing, Grinding, Cement Machinery; Motors; Texrope Drives; Centrifugal Pumps; Tractors*

**American Cyanamid Co.**
Explosives Department
2527 Oliver Bldg., Pittsburgh 22, Pa.
*Explosives and Blasting Supplies*

**American Manganese Steel Division of American Brake Shoe Co.**
389 East 14th St., Chicago Heights, Ill.
*Manganese Steel Castings, Power Shovel Dippers, Material Handling Pumps, Heat and Corrosion Resistant Castings, Reclamation and Hard-Facing Welding Materials*

**American Pulverizer Co.**
1249 Macklind Ave., St. Louis 10, Mo.
*Manufacturers of Ring Crushers and Hammermills for Primary and Secondary Crushing*

**Atlas Powder Co.**
Wilmington 99, Del.
*Industrial Explosives and Blasting Supplies*

**Austin-Western Co.**
601 N. Farnsworth Ave., Aurora 1, Ill.
*Jaw and Roll Crushers, Conveyors, Feeders, Screens, and Bins—Separately or Combined in Complete Crushing, Screening and Washing Plants; All Types of Dump, Hopper, and Quarry Cars, Air and Electrically Operated, in Narrow and Standard Gauges; Power Shovels, Drag Lines, and Cranes; Road Making, Earth Handling, and Street Cleaning Equipment*

**Bacon-Green & Milroy**
205 Church St., New Haven 10, Conn.
*"FARREL-BACON" Jaw Crushers for Primary and Secondary Operations, Conveyors, Elevators, Rolls, Screens*

**Bacon-Pietsch Co., Inc.**
149 Broadway, New York 6, N. Y.
*Manufacturers of Farrel-Bacon Crushers and Allied Screening and Conveying Equipment*

**Barber-Greene Co.**
Aurora, Ill.
*Portable and Permanent Belt Conveyors, Belt Conveyor Idlers, Bucket Loaders both Wheel and Crawler Mounted, Asphalt Mixers and Finishers, Coal Handling Machines*

**C. G. Buchanan Crushing Machinery Division of the Birdsboro Steel Foundry and Machine Co.**
1941 Furnace St., Birdsboro, Pa.
*Primary, Secondary, and Finishing Crushers and Rolls*

**Bucyrus-Erie Co.**
South Milwaukee, Wis.
*Excavating, Drilling and Material Handling Equipment*

**Cross Engineering Co.**
Carbondale, Pa.
*Screen Plates and Sections, Perforated Plate for Vibrating, Rotary and Shaking Screens*

**Cummins Engine Co., Inc.**
Columbus, Ind.
*Diesel Engines, Fuel Pumps*

**Deister Machine Co.**
1933 East Wayne St., Fort Wayne 4, Ind.
*Deister Plat-O Vibrating Screen, Deister Compound Funnel Classifier*

**Detroit Diesel Engine Division General Motors Corp.**
13400 West Outer Drive, Detroit 23, Mich.
*Light Weight, Compact 2 Cycle Diesel Engines and "Package Power" Units for All Classes of Service*

**E. I. du Pont de Nemours & Co., Inc.**
Wilmington 98, Del.
*Explosives and Blasting Accessories*

**Eagle Iron Works**
129 Holcomb Ave., Des Moines, Iowa
*Fine Material Screw Washers—Classifiers—Dehydrators; Coarse Material Screw and Log Washers—Dewaterers; Water Scalping and Fine Material Settling Tanks; and "Swintek" Screen Chain Cutter Dredging Ladders*

**Easton Car and Construction Co.**
Easton, Pa.
*Heavy-Duty Dump Body Trailers for Rock and Ore, Truck Bodies, and Quarry Cars; Overhead Hoists for Dumping Haulage Units; Electric Heaters for Tar, Asphalt or Bitumen*

**Ensign-Bickford Co.**
Simsbury, Conn.
*Primacord-Bickford Detonating Fuse and Safety Fuse*

# MANUFACTURERS DIVISION
# NATIONAL CRUSHED STONE ASSOCIATION

(continued)

**Euclid Road Machinery Co.**
1361 Chardon Road, Cleveland 17, Ohio
*Heavy-Duty Trucks and Dump Trailers for "Off-Highway" Hauls, Loaders for Earth Excavation*

**Frog, Switch & Mfg. Co.**
Carlisle, Pa.
*Manganese Steel Department—Manufacturers of "Indian Brand" Manganese Steel Castings for Frogs, Switches, and Crossings, Jaw and Gyratory Crushers, Cement Mills, Mining Machinery, Etc., Steam Shovel Parts*

**General Electric Co.**
1 River Road, Schenectady 5, N. Y.
*Electric Motors, Controls, Locomotives, Coordinated Electric Drives for: Shovels, Drag Lines, Conveyors, Hoists, Cranes, Crushers, Screens, Etc.; Coordinated Power Generating and Distributing Systems Including Turbine Generators, Switchgear, Transformers, Cable, Cable Skids, Load Center Substations*

**Gill Rock Drill Co.**
Lebanon, Pa.
*Well Drill Tools and Supplies*

**Gruendler Crusher and Pulverizer Co.**
2915 N. Market St., St. Louis 6, Mo.
*Rock and Gravel Crushing and Screening Plants, Jaw Crushers, Roll Crushers, Hammermills, Lime Pulverizers*

**George Haiss Mfg. Co., Inc., Division of Pettibone Mulliken Corp.**
141st-144th on Park Ave., New York 51, N. Y.
*Bucket Loaders, Buckets, Portable and Stationary Conveyors, Car Unloaders*

**Harnischfeger Corp.**
4400 W. National Ave., Milwaukee 14, Wis.
*A complete line of Power Excavating Equipment, Overhead Cranes, Hoists, Smootharc Welders, Welding Rod, Motors and Generators*

**HarriSteel Products Co.**
420 Lexington Ave., New York 17, N. Y.
*Woven Wire Screen Cloth*

**Hayward Co.**
50 Church Street, New York 7, N. Y.
*Orange Peel Buckets, Clam Shell Buckets, Electric Motor Buckets, Automatic Take-up Reels*

**E. Lee Heidenreich, Jr., Consulting Engineers**
67 Second St., Newburgh, N. Y.
*Plant Layout, Design, Supervision; Open Pit Quarry Surveys; Appraisals—Plant and Property*

**Hendrick Mfg. Co.**
Carbondale, Pa.
*Perforated Metal Screens, Perforated Plates for Vibrating, Shaking, and Revolving Screens; Elevator Buckets; Test Screens; Wedge Slot Screens; Open Steel Floor Grating*

**Hercules Powder Co.**
Wilmington 99, Del.
*Explosives and Blasting Supplies*

**Hetherington & Berner Inc.**
701-745 Kentucky Ave., Indianapolis 7, Ind.
*Asphalt Paving Machinery, Sand and Stone Dryers, Dust Collectors*

**Highway Equipment Co., Inc.**
616 D Ave., N. W., Cedar Rapids, Iowa
*Complete Line of Spreaders*

**Illinois Powder Mfg. Co.**
112 N. 4th St., St. Louis 2, Mo.
*Gold Medal Explosives*

**Ingersoll-Rand Co.**
11 Broadway, New York 4, N. Y.
*Rock Drills, Quarrymaster Drills, Jackbits, Bit Reconditioning Equipment, Portable and Stationery Air Compressors, Air Hoists, Slusher Hoists, Air Tools, Diesel Engines, Pumps*

**Insley Manufacturing Corp.**
801 N. Olney St., Indianapolis 6, Ind.
*Concrete Carts and Buckets, ½ Yd. Cranes and Shovels*

**Iowa Manufacturing Co.**
Cedar Rapids, Iowa
*Rock and Gravel Crushing, Screening, Conveying and Washing Plants, Hot and Cold Mix Asphalt Plants, Stabilizer Plants, KU-BIT Impact Breakers, Screens, Elevators, Conveyors, Portable and Stationary Equipment, Hammermills*

**Jeffrey Manufacturing Co.**
E. First Ave., Columbus 16, Ohio
*Material Handling Machinery, Crushers, Pulverizers, Screens, Chains*

**Joy Manufacturing Co.**
333 Oliver Bldg., Pittsburgh 22, Pa.
*Drills: Blast-Hole, Wagon, Rock, and Core; Air Compressors: Portable, Stationary, and Semi-Portable; Aftercoolers; Portable Blowers; Carpullers; Hoists; Multi-Purpose and Portable Rock Loaders; Air Motors; Trench Diggers; Belt Conveyors; Drill-Bit Furnaces; "Spaders"; "String-a-Lite" (Safety-Lighting-Cable); Backfill Tampers; Drill Bits: Rock and Core*

# MANUFACTURERS DIVISION
# NATIONAL CRUSHED STONE ASSOCIATION
(continued)

**Kennedy-Van Saun Mfg. and Eng. Corp.**
2 Park Ave., New York 16, N. Y.
*Material Handling Machinery—Crushers, Pulverizers, Vibrating Screens*

**Kensington Steel Co.**
505 Kensington Ave., Chicago 28, Ill.
*Manganese Steel Castings, Dipper Teeth, Crawler Treads, Jaw Plates, Concaves and Hammers*

**Keystone Driller Co.**
Beaver Falls, Pa.
*Drills, Power Shovels*

**King Powder Co., Inc.**
Cincinnati, Ohio
*Detonite, Dynamites, and Blasting Supplies*

**Koehring Co.**
3026 W. Concordia Ave., Milwaukee 10, Wis.
*Mixers, Pavers, Shovels, Cranes, Draglines, Dumptors, Traildumps, Wind-Jacks*

**Kraft Bag Corp.**
630 Fifth Ave., New York 20, N. Y.
*Heavy Duty Multiwall Paper Bags*

**Lima Shovel and Crane Division**
**Lima-Hamilton Corp.**
Lima, Ohio
*Power Shovels, Draglines, and Cranes*

**Link-Belt Co.**
300 West Pershing Road, Chicago 9, Ill.
*Complete Stone Preparation Plants; Conveyors, Elevators, Screens, Washing Equipment, Speed-O-Matic Shovels—Cranes—Draglines and Power Transmission Equipment*

**Ludlow-Saylor Wire Co.**
Newstead Ave. & Wabash R. R.
St. Louis 10, Mo.
*Woven Wire Screens and Wire Cloth of Super-Loy, Magna-Loy and All Commercial Alloys and Metals*

**Mack Manufacturing Corp.**
350 Fifth Ave., New York 1, N. Y.
*On- and Off-Highway Trucks, Tractor Trailers, Six-Wheelers, from 5 to 30 Tons Capacity, both Gasoline- and Diesel-Powered*

**Marion Power Shovel Co.**
Marion, Ohio
*A Complete Line of Power Shovels, Draglines, and Cranes*

**McLanahan & Stone Corp.**
200 Wall St., Hollidaysburg, Pa.
*Complete Pit, Mine, and Quarry Equipment —Crushers, Washers, Screens, Feeders, etc.*

**Murphy Diesel Co.**
5317 W. Burnham, Milwaukee, Wis.
*Murphy Diesel Engines Ranging from 90 to 165 Continuous Horsepower at 1200 Rpm. and Packaged Type Generator Sets 60 to 106 Kw. for All Classes of Service*

**New Holland Machine Co.**
New Holland, Pa.
*Limestone Pulverizers; Jaw, Roll, and Hammer Crushers; Elevators; Revolving and Vibrating Screens; Dewaterers; Belt and Apron Conveyors; Conveyor Belting; V-Belts; V-Belt Drives; Engines; Electric Motors; Concrete Mixers With or Without Power Lifts*

**Noble Co.**
1860 7th St., Oakland 7, Calif.
*Batching Plants, Bulk Cement Plants*

**Nordberg Mfg. Co.**
307 S. Chase Ave., Milwaukee 7, Wis.
*Cone, Gyratory, Jaw and Impact Crushers; Grinding Mills; Stone Plant and Cement Mill Machinery; Vibrating Screens; Grizzlies; Diesel and Steam Engines; Compressors; Mine Hoists; Track Maintenance Tools*

**Northern Blower Co.**
W. 65th St., South of Denison
Cleveland 2, Ohio
*Dust Collecting Systems, Fans—Exhaust and Blower*

**Northwest Engineering Co.**
135 S. LaSalle St., Chicago 3, Ill.
*Shovels, Cranes, Draglines, Pullshovels*

**Pennsylvania Crusher Co.**
Liberty Trust Bldg., Philadelphia 7, Pa.
*Complete Line of Crushing Equipment*

**Pioneer Engineering Works, Inc.**
1515 Central Ave., Minneapolis 13, Minn.
*Jaw and Roll Crushers, Vibrating and Revolving Screens, Scrubbers, Belt Conveyors, Traveling Grizzly Feeders*

**Pit and Quarry Publications**
538 South Clark St., Chicago 5, Ill.
*Pit and Quarry, Pit and Quarry Handbook, Pit and Quarry Directory, Concrete Manufacturer, Concrete Industries Yearbook*

**Quaker Rubber Corp.**
Tacony and Milnor Sts., Philadelphia 24, Pa.
*Conveyor Belts, Hose, and Packings*

## MANUFACTURERS DIVISION
# NATIONAL CRUSHED STONE ASSOCIATION
(concluded)

**Robins Conveyors Division, Hewitt-Robins Incorporated**
370 Lexington Ave., New York 17, N. Y.
*Belt Conveyors, Bucket Elevators, Gyrex and Vibrex Screens, Feeders, Design and Construction of Complete Plants*

**Rock Bit Sales and Service Co.**
350 Depot St., Asheville, N. C.
*Tungsten Carbide Detachable Bits, "Rock Bit" Drill Steel Inlaid with Tungsten Carbide, Carbon Hollow Drill Steel, Alloy Hollow Drill Steel*

**Rock Products**
309 West Jackson Blvd., Chicago 6, Ill.

**John A. Roebling's Sons Co.**
640 S. Broad St., Trenton 2, N. J.
*Aggregate Screen, Hardware and Industrial Wire Cloth, Insect Screening, Wire Rope, Fittings and Strand, Slings, Suspension Bridges and Cables, Aerial Wire Rope Systems, Ski Lifts, Electric Wire and Cable, Magnet Wire*

**Sanderson-Cyclone Drill Co.**
South Main St., Orrville, Ohio
*All Steel Wire Line, Air Speed Spudders, Large Blast Hole Drills, Drilling Tools and Drilling Supplies*

**Screen Equipment Co.**
1754 Walden Ave., Buffalo 21, N. Y.
*SECO Vibrating Screens*

**Simplicity Engineering Co.**
Durand, Mich.
*Simplicity Gyrating Screen, Simplicity D'centegrator, Simplicity D'watering Wheel*

**Smith Engineering Works**
E. Capitol Drive at N. Holton Ave.
Milwaukee 12, Wis.
*Gyratory, Gyrasphere, Jaw and Roll Crushers, Vibrating and Rotary Screens, Gravel Washing and Sand Settling Equipment, Elevators and Conveyors, Feeders, Bin Gates, and Portable Crushing and Screening Plants*

**St. Regis Sales Corp.**
1925 O'Sullivan Bldg., Baltimore 2, Md.
Main Office: 230 Park Ave., New York 17, N. Y.
*Automatic Filling and Weighing Machines and Multiwall Paper Shipping Sacks*

**Stedman's Foundry & Machine Works**
Aurora, Ind.
*Stedman Impact-Type Selective Reduction Crushers, 2-Stage Swing Hammer Limestone Pulverizers*

**Stephens-Adamson Mfg. Co.**
Aurora, Ill.
*Belt Conveyors, Elevators, Feeders, Car Pullers, Screens, Skip Hoists, Complete Plants*

**Taggart Corp.**
(See St. Regis Sales Corp.)

**W. O. & M. W. Talcott, Inc.**
91 Sabin St., Providence, R. I.
*Belt Fasteners, Belt Lacing, Conveyor Belt Fasteners, and Patch Fasteners*

**Taylor-Wharton Iron & Steel Co.**
High Bridge, N. J.
*Manganese and Other Special Alloy Steel Castings*

**Thew Shovel Co.**
Lorain, Ohio
*Power Shovels, Cranes, Crawler Cranes, Locomotive Cranes, Draglines, Diesel Electric, Gasoline, 3/8 to 2 1/2 Cu. Yd. Capacities*

**Traylor Engineering & Mfg. Co.**
Allentown, Pa.
*Stone Crushing, Gravel, Lime, and Cement Machinery*

**Trojan Powder Co.**
17 N. 7th St., Allentown, Pa.
*Explosives and Blasting Supplies*

**W. S. Tyler Co.**
3615 Superior Ave., N. E., Cleveland 14, Ohio
*Wire Screens, Screening Machinery, Scrubbers, Testing Sieves and Dryers*

**Universal Engineering Corp.**
625 C Ave., N. W., Cedar Rapids, Iowa.
*Jaw Crushers, Roll Crushers, Hammermills, Complete Crushing, Screening, and Loading Plants, Either Stationary or Portable for Stone Aggregates or Aglime*

**Vibration Measurement Engineers**
7705 Sheridan Rd., Chicago 26, Ill.
*Specialists in Blasting Complaint Investigations; Seismological Surveying; Expert Testimony in Blasting Litigation*